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Transforming Teacher Education through Technology: An Analysis in the Context of NEP 2020

[*1]Sabiha Khan

[*1]Assistant Professor, Department of B.A. Mass Media, Smt. P.N. Doshi Women's College, Mumbai, Maharashtra, India.

Abstract

The National Education Policy (NEP) 2020 marks a new era in education in India, very focus on technology as a means of transforming teacher education. In this research paper, we examine how NEP 2020 articulates the use of technology across pre-service and in-service teacher education, and its use in developing pedagogical skills, forming a continuous professional development process, and developing inclusive and scalable learning settings. Through an analysis of policy direction, platforms such as DIKSHA, SWAYAM, and NISHTHA, and implementation concerns, this paper provides opportunities and challenges of the technology-facilitated transformation. It also recognizes the need to close the digital divide, ensure necessary infrastructure, develop an innovative approach to teacher education, and provide opportunities for continuous professional development. Finally, evidence-based recommendations are provided to develop equitable, effective, and sustainable technology-consistent of NEP 2020's educational vision for developing a strong future workforce of teachers.

Keywords: NEP 2020, Teacher Education, Technology Integration, Digital Pedagogy, Professional Development, EdTech, Education Reform, Inclusive Learning, Lifelong Learning.

1. Introduction

As rapid globalization, technological innovations, and shifts in the labor market continue to shape education systems across the world, there is a radical transformation occurring in education. Most educational changes are driven by the changing demands of knowledge societies where access to technology and information is paramount. Central to this transformation is the teacher, recognized in every context as the most important factor in creating student success and, ultimately, improving educational systems. A teacher functions not only as a source of information or knowledge but also functions as a mentor, counselor, and guide to prepare students for the increasing complexity of their workspace in the world. In India, teacher education has typically been seen as traditional teacher education, taught as conventional pedagogy, with the curriculum fixed, not much technology, and one-off training that usually does not meet the needs of actual practitioners. While traditional teacher education and teaching have many merits, they do not provide educators with all the skills they require to manage the realities of contemporary classrooms where digital literacy, customized learning, and collaborative pedagogies are becoming the norm. This suggests that teacher education in India has real obstacles in meeting the recent changes facing education today.

Nevertheless, the National Education Policy (NEP) 2020 implicitly indicates a decisive evolution to a broader, holistic, dynamic, and future-ready contextual approach to teacher preparation and ongoing professional development. The NEP envisions a complete transformation of the educational ecosystem, where technology will be at the core of how teachers are prepared, supported, and empowered. The NEP is also envisaging a systems-oriented approach that would establish a more readily inclusive, learner-centered approach to learning about and engaging meaningfully with the new realities and relationships of content knowledge, which is not only subject knowledge but also being literate in well-exercised digital pedagogical knowledge, collaborative inquiry and research utilizing relationships with knowledge, and knowledge-critiquing thinking/learning approaches essential to being inducted memorably and productively into the 21st-century educational experience.

The role of technology in teacher education is a key aspect of NEP's vision. Technology is viewed not just as an add-on but as a core enabler of innovation and inclusivity and quality improvement in teacher education. In this paper we explore how NEP 2020 proposes a framework for embedding digital resources to create a teaching workforce capable of being resilient, reflective, and technologically proficient. It will also briefly note some of the key enablers and barriers to effective implementation, sensitive to India's varied socioeconomic context and educational disparities. Using examples of how digital tools and platforms such as DIKSHA, SWAYAM, and NISHTHA can be used for professional development, this

***Corresponding Author:** Sabiha Khan

paper will demonstrate technology's potential for transforming teacher education and provide some recommendations for overcoming the current challenges.

2. Research Objectives

This research mainly aims to investigate how technology is shaping teacher education in India in light of India's National Education Policy (NEP) 2020. The specific objectives include:

i). To examine NEP 2020's policy vision for the use of technology in teacher education and professional development.
ii). To evaluate the effectiveness of digital platforms like DIKSHA, SWAYAM, and NISHTHA in providing scalable and accessible training for teachers.
iii). To examine the changes in teachers' teaching style, classroom practice, and teacher motivation as a result of technology-enabled training.
iv). To identify the key number of challenges experienced by educators and institutions in adopting conditions for tech-based training, such as infrastructures and digital literacy.
v). To review the regional differences and best practices existing from EdTech to teacher education in different states in India.
vi). To provide strategic recommendations for interventions for improving digital teacher education through inclusive content, support mechanisms, and policy enforcement.

3. Literature Review

The changing role of technology within teacher education has been widely analyzed in various global and national contexts; previous research provides useful evidence about how pedagogies may change. One of the earliest outlines for understanding how pedagogy, content, and technology could change together was developed by Mishra & Koehler (2006) [3] under the Technological Pedagogical Content Knowledge (TPACK) model, which argued that education faculty could leverage technological tools with their expertise to develop a thoughtful integration of things they know about content and pedagogical strategies. This framework provides pedagogical principles that teacher education faculties now utilize as educational philosophies based on skill sets and not memorized knowledge.

UNESCO (2018) [2] also suggests that the use of ICT (Information and Communication Technology) for education could overcome significant barriers to quality teacher training and education, especially in times of significant access disparity. With the adoption of digital platforms, the content can be more scalable, ongoing and professional learning is achievable, and learning spaces can be more adaptable, interactive and learner centered. Selwyn (2012) [4] notes that digital technology has the potential for education to improve equitable access and offer greater opportunities for students to engage in deeper learning experiences; and also engage with their peers in collaborative and reflective practice.

In the Indian context, the National Education Policy 2020 lays out various changes that prioritize technology in relation to teacher preparation and professional learning. As mentioned in the reports shared by the Ministry of Education (2020) [1], NEP 2020 recognizes the role of digital resources, mobile learning, and asynchronous online modules as important mediums to help with teachers' effectiveness and accountability. NEP 2020 also involves a shift from the traditional "chalk and talk" pedagogies to more equitable training modes that are technology-mediated and promote lifelong learning.

Government initiatives like DIKSHA, SWAYAM, and NISHTHA are central to achieving this vision. For instance, DIKSHA offers multilingual materials, subject lesson plans, interactive assessment resources, and virtual classrooms for in-service and pre-service teachers. According to NCERT, DIKSHA enabled access to and participation in teacher training for many, especially during COVID-19, when only remote training was available.

In addition, SWAYAM (Study Webs of Active Learning for Young Aspiring Minds) and NISHTHA (National Initiative for School Heads' and Teachers' Holistic Advancement) offer comprehensive MOOC-style learning for teachers where they can receive training in pedagogical content, digital skills, and socio-emotional competence. Kumar & Singh (2022) state these platforms are transforming the scale and quality of teacher education in India by providing access, flexibility, and self-paced learning.

Research by Banerjee (2023) explores the effects of virtual classrooms, AI-enabled tutoring systems, and mobile learning apps, stating that these types of learning tools help scaffold a range of differentiated instruction and accommodate the needs of different learners. However, the research also warns about the potential negative effects of the digital divide, including contrasting experiences of limited internet, limited devices, and low digital literacy, especially in rural contexts, which could erode the impact of EdTech projects.

A thorough interrogation of case studies of regional projects focused on the implementation of the NEP's aims around ICT, such as have been conducted in states like Maharashtra, Karnataka, and Kerala, shows that there are both examples of good practice and poor practice. It seems those states that have reasonably robust ICT infrastructure and established teacher support systems were better able to enact/adapt to NEP-recommended ICT changes, whereas states with ICT issues (funding, training, and relevance) seem to have ongoing concerns.

4. NEP 2020: Key Technological Provisions for Teacher Education

i). **Digital Platforms:** DIKSHA (Digital Infrastructure for Knowledge Sharing) is a national platform that provides high-quality educational content, including lesson plans, teaching aids, and video-based learning modules for PLN participants. It is dedicated to both pre-service and in-service teachers. DIKSHA is widely available, customizable, aligned with state standards, and in multiple languages. SWAYAM and SWAYAM Prabha offer Massive Open Online Courses (MOOCs) at no charge hosted by top-tier institutions, allowing teachers to upgrade their skills on demand. Not only do these platforms proliferate access to world-class learning materials, they promote an ongoing cycle of improvement through self-directed learning. NISHTHA (National Initiative for School Heads' and Teachers' Holistic Advancement) takes this concept even further by combining blended mode training modules, peer learning, and applied field experiences, with a key focus on subject-specific knowledge, interaction strategies for use in the classroom and ongoing teacher motivation.

ii). **National Educational Technology Forum (NETF):** The National Educational Technology Forum is an independent body envisaged under NEP 2020 to help share ideas on EdTech innovations and policy development. NETF is intended to be a source of

technological good practice, promote research output, and create innovative synergies across sectors. By bringing together educators, researchers, and technologists, NETF will help shape curriculum, teacher standards, and digital infrastructures for holistic and future-fit teacher education.

iii). **Continuous Professional Development (CPD):** The NEP 2020 specifies that teachers are required to undertake a minimum of 50 hours of continuous professional development (CPD) each academic year. CPD activities can be undertaken online, through a mobile app, or offline, giving teachers the option of more flexible participation. CPD modules offer teachers a diverse range of CPD topics such as digital skills, inclusive education, assessments, and subject pedagogy. CPD modules are designed to develop teachers competencies across a period of time, allowing them to keep their current qualifications relevant in an emergent educational future.

5. The Role of Technology in Transforming Teacher Education

The use of technology in teacher education has changed the landscape of how educator preparation, support, and empowerment are carried out throughout their professional lives. Formerly teacher education was offered via an inflexible structure that confined teacher training in terms of quality and content while delaying any professional development training due to the use of resources associated with in-person training sessions, which typically happened infrequently. With the proliferation of digital learning platforms and online learning ecosystems, teacher education has evolved into a profession that is more inclusive, scalable, and able to respond to educational needs in real-time. One of the most notable changes brought about by technology has been the democratization of access to training resources.

Digital learning platforms, like DIKSHA and SWAYAM have allowed for teachers in rural and impoverished areas to participate in highly effective professional development when it might not have been otherwise possible due to location and lack of resources. These platforms have many other learning access points both synchronous and asynchronous, meaning that teachers were able to access additional options to learn. Both platforms offered different learning types using multimedia, interactive assessments and modular courses to fit a range of educational needs and allow for arbitrary timelines, which was helpful during constrained professional time.

Another promising aspect of technology in teacher education is the potential for establishing collaborative learning communities. These collaborative communities consist of online forums, virtual classrooms, and professional learning networks that allow teachers to share their experiences, co-design resources, and engage in thoughtful conversation with peers and experts from around the country. These communities help foster development as a collective and facilitate the exchange of knowledge and experience, combatting professional isolation and building stronger support within a teaching community. Such exchange of knowledge creates continuous loops of feedback, which helps to influence policy, platform development, and opportunities for pedagogical innovations.

i). **Personalized and Flexible Learning:** Digital technology lets us personalize learning experiences, which is one of the best advantages of technology in teacher education. Self-paced modules promote professional development that meets the needs of an educator's own learning style, interests, and subject area. In addition, digital resources that are provided in multiple languages also advance professional growth for teachers from regional and marginalized areas. Flexibility in time and access removes the restrictions that historic workshop-based training created and takes individual professional development to a new place. Such supported learning is inclusive and responsive.

ii). **Real-Time Feedback and Assessment:** By integrating artificial intelligence and data analytics into EdTech platforms, real-time feedback and performance tracking can occur. For example, teachers receive up-to-date evaluations of quizzes, reflective tasks, and lesson plans. As a result, any course correction necessitated can be shorter, allowing a more substantial focus on improvement and the establishment of a reflective practice culture. The use of state-of-the-art tools helps institutions track student learning outcomes, as well as any professional development needs on an institutional level.

iii). **Simulated and Immersive Learning:** The emergence of immersive technologies like Augmented Reality (AR) and Virtual Reality (VR) has completely transformed the manner in which educators can practice and grow their teaching practice. In providing scenario-based simulations that integrate AR and VR into real-world or classroom-like environments, immersive technologies enable educators to explore and practice classroom management, assess students, and implement inclusive teaching strategies within safe environments. With the help of VR and AR, teachers are offered access to a range of classroom environments that includes large and diverse classroom management scenarios and situations that address specific challenges related to inclusive education and student behavior. These immersive technologies also provide immediate feedback to educators to help them evaluate how they performed in a specific situation and how they can enhance or improve their performance, similar to how aviation training routinely uses flight simulators for pilots to develop their skills. Furthermore, simulation-based education opportunities can also be paired with AI-based analytics to monitor and track a teacher's performance, informing areas for improvement as well as recognizing areas of strength. Given the multitude of challenges faced by educators, these technologies represent a new opportunity for them to practice developing their craft in a safe, confident, and knowledgeable environment, making teacher training both fun and engaging.

iv). **Communities of Practice:** Digital platforms serve as the basis for active and engaged communities where educators collaborate, share ideas, reflect on pedagogical actions, develop learning resources together, and generally support one another, emotionally and pedagogically. These communities emphasize ongoing professional learning and collaborative learning, which in turn help educators professionally grow and stay connected to others, in particular in regions that are more isolated or spread out geographically. Community members will share more than the details of their strategies for teaching—a community can be a place for educators to reciprocally give and receive peer feedback, share problems of practice from their classrooms, and

share stories of success; typically more valuable in situations where educators are in more rural or remote areas without many in-person learning or professional development opportunities or access to experts. The nature of the virtual space supports informal synchronous, asynchronous, and multi-modal interaction and participation amid competing schedules and time zones. In addition, educators participate in professional practice by engaging regularly in online discussion forums, participating in webinars, and attending virtual workshops; all create many dynamic spaces for collective reflection and problem solving that contribute to the development of a more shared vision for improvement in education. Ultimately, these networks allow for professional learning but also social connectivity, emotional support, and the establishment of a sense of belonging among educators. In particular, communities of practice that are created, supported, and enhanced digitally provide an efficient and scalable solution in terms of helping educators thrive.

6. Challenges in Implementation

Although considerable progress has been made, the integration of technology into teacher education still experiences a myriad of ongoing obstacles. These barriers are multifaceted and include the continuing digital divide, and we see this divide manifesting in the inequitable availability of internet access, the availability of digital technology on which teacher education is reliant, and availability of reliable energy supply, along with access to basic electrical wiring, all especially in rural and tribal areas of India. The forms of systemic inequalities of access and availability creates a disproportionate impact for historically marginalized groups, as well as challenges to national efforts in providing high quality, equitable and engaging teacher education to educators in very different contexts. Furthermore, technology experience, technology familiarity, technology readiness, and belief in technology use by teachers can produce a considerable variation. A significant number of teachers, particularly those working in remote or disadvantaged areas, have little knowledge and digital literacy to engage with the benefits that digital platforms can offer, let alone navigate the useful features. When there is a gap in engagement and knowledge to functionally use the available materials, frustration can develop, leading to low engagement and a belief that it is not possible to use those tools confidently and effectively in their practice, which diminishes the potential, transformative purpose of any digital training program.

Furthermore, aspects of quality and context-specificity for digital content remain problematic. Teachers consistently affirm that a large proportion of digital training modules are quite general or abstract, making the use of the knowledge and strategies in every-day classroom contexts difficult. For instance, teachers do not want to perform in a bag labelling activity for design thinking but want very prescribed activities and very local examples; too often digital training modules do not provide either. In addition, teachers are already time poor; the majority of busy teachers do not have lengthy amounts of professional development time prior to starting their teaching. Although there should be institutional supports to encourage teachers to undertake digital training they are often lacking and, again, pathways for mentoring are often absent. Finally, administration fragmentation, and different levels of doing, further complicate the issue of a united approach to technology-based teacher education at a national level.

7. Methodology

This research uses a qualitative approach that is based on policy analysis as well as a review of secondary data sources. The primary documents reviewed were NEP 2020, implementation guidelines provided in an MoE document, and reports related to training initiatives from NCERT and other government agencies. The study also investigates case studies of use of a digital platform in the field including case studies of DIKSHA and NISHTHA implementations in Maharashtra, Karnataka and Kerala to gather information about regional differences, practices that have been successful, and notions of improvement. The case studies also helped triangulate knowledge of the circumstances on the ground. In addition to the various documents outlined above, interviews and published accounts of experiences from educators who have attended tech-based training were also reviewed as a way to understand the reality.

Data Collection

Data for this study was gathered using a structured survey, which was designed specifically to measure technology-related integration into teacher education under the NEP 2020. The survey respondents were both pre-service and in-service teachers (teachers currently employed in a teaching position) in order to secure a breadth of responses and balance perspectives. Pre-service and in-service teachers were recruited from a variety of geographical locations and sites (urban and rural) to ensure that the survey provided balanced perspectives. The survey was comprised of a mix of both closed and open-ended questions, with a focus on questions in the following areas: the degree to which respondents acknowledged the NEP 2020 (deadline for participation was in 2021); the extent to which they had used digital platforms (DIKSHA, SWAYAM, NISHTHA, etc.); the extent to which technology can be accessed. etc.; very poor, poor, neutral, good, very good; perceived effectiveness of the digital training for equity, effectiveness, and impact of the technology... etc. The questionnaire was shared online through digital platforms (Google forms) for use in educational networks, ensuring the accessibility of the survey. Qualitative feedback was also encouraged through open response questions to provide a deeper understanding of lived experiences from more mindful educators and staff. Ethics considerations were maintained by ensuring anonymity and voluntary participation of all respondents. The collected data provided a wide-ranging and general view of what is currently occurring in digital transformation of teacher education, with features of what challenges, and opportunities were available.

Data Analysis

According to the data from the survey, we used both descriptive and interpretive methods of analysis to gain insight into the perceptions, experiences, and tensions of educators regarding their use of technology in teacher education, following NEP 2020. The findings suggested that there was a considerable level of awareness among educators on the policy with implications for policy and practice around digital learning. The majority of participants acknowledged having used or interacted with government-sponsored platforms such as DIKSHA, SWAYAM, and NISHTHA as representations of technology-induced forms of development for educator professional development.

From the analysis, we also saw significant diversity in access to digital infrastructure across regions. Teachers in urban communities suggested that they had much more access to

devices and data than their rural counterparts. This suggested a deepening digital divide in education practice. Generally speaking, although most participants suggested online training provided useful ideas and strategies to support a shift in their teaching, many participants felt that the content was not relevant to their particular context and contained no hands-on components, and thus had limited applicability in the real classroom environment.

The demand for multilingual and interactive learning formats was common, as was the desire for ongoing support in the form of mentoring and peer collaboration. The data showed that teachers who participated in technology-driven CPD on a regular basis expressed greater confidence in and commitment to innovative teaching practices.The teachers indicated that the most common barriers to technology related CPD were time limitations, a lack of technical support and poorly designed technology based training.

In conclusion, the data suggests some advancement, but considerable barriers, to the digital transformation of teacher education. The analyses support a combination of blended learning, infrastructure, locally created content and ongoing opportunities for engagement and capacity building.

8. Result and Final Discussion

The survey was administered to a variety of educators, including both pre-service and in-service teachers from urban and rural locations throughout India. The survey was primarily aimed at assessing their awareness of NEP 2020, the use of EdTech platforms, the perceived benefits, and the challenges of technology-integrated teacher training.

Key Findings Include:

- **Awareness of NEP 2020:** A total of 82% of the respondents were aware of NEP 2020 and its emphasis on digital learning and teacher development. Only 54% identified the direct implications for their own professional training.
- **Usage of Digital Platforms:** 76% had used a government platform such as DIKSHA, SWAYAM, or NISHTHA. Of these platforms, DIKSHA was most commonly used and was viewed positively because it provided resources in multiple languages and was easily accessible. Throughout the study, many participants expressed the need for more interactive and practice-based modules.
- **Access to Digital Infrastructure:** Almost 40% of participants were from rural areas and reported challenges connecting to stable internet and having access to the digital devices. In contrast, 80% of urban educators had access to smartphones or laptops (for the purpose of training).
- **Professional Growth and Skill Development:** 68% of teachers agree that the digital training was beneficial in enhancing their pedagogical and technology implementation skillsets. Furthermore, teachers who attended training frequently during digital learning sessions and blended learning sessions reported having more confidence in their attitudes towards online and blended learning.
- **Preferred Training Features:** Regarding the most valued characteristics identified among educator-specific training programs (I.e. e-learning, online professional development, etc.), interactive modules (65.4%), provided real-time feedback on their progress (52%), offered in local languages (48.3%).
- **Challenges Identified:** The most often cited issues included time restrictions (59%), lack of technical assistance (41%), and difficulty connecting content to reality in the classroom (37%).

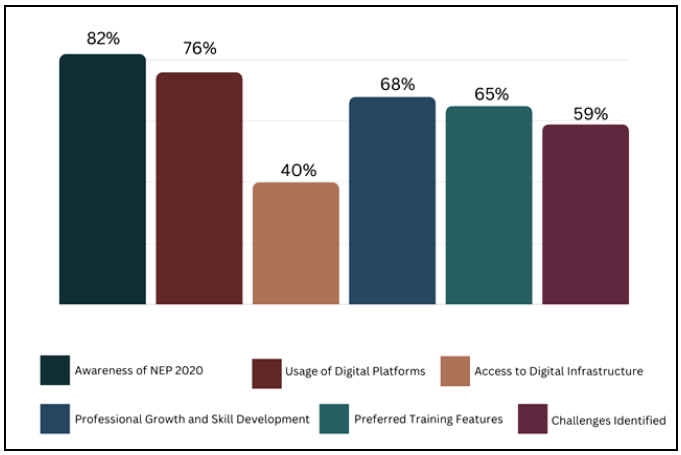

Fig 1: Transforming teacher education through technology: An analysis in the context of NEP 2020

These results reveal not only the advances and the opportunities afforded to technology-enabled teacher education in India but also the systemic gaps in infrastructure, accessibility, and content design, through which no level of experience, prior knowledge, or interests can be easily accommodated. The results outline the empirical basis for the ultimate discussion and recommendations of this study.

The advancement of technology into teacher education has increased participation in online professional development (PD) programs, especially during and after COVID-19. Many report being more familiar with using digital tools and suggest improved interaction when utilizing online activities in the classroom. PD platforms also enabled more equity, and educators in remote locations were able to access quality resources. Disparities in access and usage persist, as states, who bolster resources, infrastructure, and support services have had a wider reach and availability to PD compared to others. Teachers have prompted for more engaging, practice-based training rather than viewing instructor-led webinars and colleagues speak about their use of digital tools. Overall, the study verifies that technology is indeed transforming teacher education digitally. Nevertheless, certain structural aspects of access, infrastructure, support, and quality are being led by an innate pace; thus, creating a further challenge to anticipate and develop consistency regarding quality and consistent access uniformly over time.

The participants' report has provided some important input regarding the context of technology-mediated teacher education in India, particularly in relation to NEP 2020. Furthermore, a majority of the participants understood the digital components of the NEP 2020. Interestingly, all the participants indicated total willingness to engage with technology in their professional learning and development. This is an important step in changing the thinking of educators, which is the first step to enabling the policy change we desire.

Many educators had used platforms such as DIKSHA, SWAYAM and NISHTHA, which suggests that there is growing familiarity with government-backed EdTech initiatives. These platforms are significant as they have started to provide flexible, accessible, and context-appropriate training resources. However, the survey created some concerns regarding access to digital infrastructure. A sample of educators in rural and semi-urban areas were revealing a

split between having access and not having access to the tools for digital learning. In these areas, they still lack access to the broadband internet, as well as the digital and connectivity devices, and these barriers to participate in online training are still a very real concern.

The respondents further described their desire for training modules that were interactive, real-world focused, and contextually aligned with their classrooms. It was noted that digital content can be informative, but teachers wanted hands-on applications made real-time with engagement. Thus, it seems we need more context-reliant practice-based training models.

Alongside research on implications for training modules, teachers also discussed their view of ongoing mentorship, colleague help, and developing recognition. The increased demand for location-based and multilingual content also seemed to be a repeated theme-suggesting an irritate need for respect for cultural-relevant inclusive digital education content.

Many educators noted increased confidence in their teaching practice using digital tools, in spite of the challenges, illustrating the wonderfully attuned outcome of thoughtfully designed training opportunities. Teachers also had a better understanding of how technology supported the design and implementation of new pedagogical ideas such as flipped classrooms, blended classrooms, or working with gamified instruction.

9. Recommendations

To further enhance the integration of technology in teacher education, the following actions are suggested. Firstly, in unserved regions, it is important to first build the capacity of the infrastructure by providing an internet connection, devices, and electricity. Governments and the private sector should cooperate to explore what resources can be mobilized to achieve this. In addition, it will be important to be aware of localized and multilingual content, e-learning modules that are helpful for best practices and provide interactive and activity-based learning experience. Finally, establish educational mentorship programs that have clearly defined expectations that teachers have to fulfill to improve their digital capabilities.

It is important that they receive continuous updates and support from help desks, peer coaches or virtual communities to allow for acceptable levels of individual and collective feedback for improved adoption of technology. Finally, it will be important to build up monitoring and evaluation methods, which could utilize data dashboards to help keep track of progress in relation to training activities, and to support further policy recommendations. The extent to which teachers embed technology into their practice will depend on the incorporation of their ongoing feedback and a focus on maintaining a learner-centered approach in line with each program.

10. Conclusion

NEP 2020 marks a paradigm shift in education, in India, with technology at its foundation. With respect to teacher education, this means a transition from traditional training models to dynamic, digital ecosystems that deliver access, personalization and impact. We have seen promising developments, but realizing the true potential of the policy will require us to reflect on the shortcomings of specific infrastructural areas, consider accessibility and inclusiveness, and encourage a culture of lifelong learning. By investing in technology, developing supportive structural networks, and focusing on inclusive content creation, India has the opportunity to position its educators as proactive agents of educational change and transformation. Focused efforts to ensure equitable access, ongoing support, and contextualized material will ultimately contribute to a digitally empowered teaching workforce that meets the demands of the 21st century.

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